Protestants who were filling England with shrieks and denunciations. Perhaps the most singular attempt against geology was that made by a fine specimen of the English Don, Dean Cockburn of York, to *abuse* its champions out of the field. Without apparently the simplest elementary knowledge of geology, he opened a battery of abuse. He gives it to the world at large by pulpit and press; he even inflicts it upon leading statesmen by private letters. But these weapons did not succeed. They were like Chinese gongs and dragon lanterns against rifled cannon. Buckland, Pye Smith, Lyell, Silliman, Hitchcock, Murchison, Agassiz, Dana, and a host of of noble champions besides, pressed on the battle for truth was won. And was it won merely for men of science? The whole civilized world declares that it was won for religion; that thereby has infinitely increased the knowledge of the power and goodness of God."

The lecturer classed the present opposition of the Catholics to the Free School system in this country among the long list of battles between science and theology and concluded his lecture as follows:

"But, my friends, I will not weary you with so recent a chapter in the history of the great warfare extending through the centuries. There are cheering omens. The greatest and best men in the churches—the men standing at centers of thought—are insisting with power, more and more, that religion shall no longer be tied to so injurious a policy—that searchers for truth, whether in Theology or Natural Science, shall work on as friends, sure that, no matter how much at variance they may at times seem to be, the truths they reach shall finally be fused into each other. No one need fear the result. No matter whether science shall complete her demonstration that man has been on the earth six thousand years or six hundred thousand. No matter whether she reveal new ideas of the Creator or startling relations between his creatures—the result, when fully thought out, will serve and strengthen religion not less than science. The very finger of the Almighty has written on history that science must be studied by means proper to itself, and in no other way. That history is before us all. No one can gainsay it. It is decisive, for it is this: There has never been a scientific theory framed for the use of Scriptural texts, which has been made to stand. This fact alone shows that our wonderful volume of sacred literature was not given for any such purpose as that to which so many earnest men have endeavored to wrest it. The power of that volume has been mighty indeed. It has inspired the best deeds our world has known. Despite the crusts which men have formed about it—despite the fetters which they have placed upon it—Christianity has blessed age after age of the past, and will go on as a blessing through age after age of the future. Let the Warfare of Science, then, be changed. Let it be a warfare in which religion and science shall stand together as allies, not against each other as enemies. Let the fight be for truth of every kind against falsehood of every kind—for justice against injustice—for right against wrong—for beauty against deformity—for goodness against vice—and the great warfare which has brought so many sufferings, shall bring to the earth God's richest blessings."

HOW FRENCH BANK NOTES ARE MADE.

When a new batch of French notes is to be printed, an equivalent number of the choicely prepared and preserved sheets of paper is handed over to the superintendent of the printing office. This office is among the inner buildings of the Bank of France, and is governed by very rigorous rules in all things. The operatives are all picked men, skillful, active, and silent. The sheets, the ink, and the matrixes of the plates are kept securely under lock and key until actually wanted. The printing is effected by steam-worked presses. The ink is blue, and its composition known only to a few of the authorities. An inspector goes his rounds during the continuance of the operations, watching every press, every workman, every process. A beautiful machine, distinct from the press, is employed to print the variable numbers on the note; fed with sheets of paper, it will number a thousand of them in succession, changing the digits each time, and scarcely requiring to be touched meanwhile; even the removal of one note and the placing of another are effected by automatic agency. At every successive stage the note is examined. So complete is the registration of everything that a record is always at hand of the number of sheets rejected ever since the Bank of France was established, be its defects in the paper, the printing, or the numbering. When the master-printer has delivered up his packets of printed and numbered sheets, each note is stamped with the signature of the Secretary-General and the Comptroller. This completes the *creation* of notes. The notes so created are kept in a strong box, of which the Secretary-General and the Comptroller have keys, and are retained until the day of *issue*. The chief cashier tells the Governor that he wants a new supply of a particular denomination of notes, the Governor tells the council, the council tell the secretary-general and the comptroller, and these two functionaries open their strong box, and hand over the notes demanded. The notes at this time are not really money; they do not become so until the chief cashier has put his signature to each, and registered its number in a book.

The life of a French bank note is said to average two or three years, and does not terminate until the condition is very shaky indeed—crimpled, pierced with pinholes, corner creases torn, soft, tarnished, decrepit while yet young. Some have been half-burned; one has been found half digested in the stomach of a goat, and one boiled in a waistcoat-pocket by a laundress. No matter; the cashier at the bank will do his best to decipher it; he will indeed take an infinity of trouble to put together the ashes of a burned note, and will give the owner a new note or the value in coin, if satisfied of the integrity of the old one. The bank authorities preserve specimens of this kind as curiosities, minute fragments gummed in their proper position on a sheet of paper. Very few of the notes are actually and irrevocably lost. During the last sixty-seven years 24,000 bank notes of 1,000 francs each have been issued, and of this number 23,958 had been returned to the bank by the month of January 1869, leaving only 42 unaccounted for. Whether these 42 are still in existence, or have been burned into uncollected ashes, or are at the bottom of the sea, or elsewhere, is not known. Of 500-franc notes, 24,935 have been returned out of 25,000. The bank holds itself morally and financially responsible for the small number of notes unreturned, ready to cash them if at any time presented.

The bank sends the old notes again and again into circulation, if verified and usable; but they are examined first, and any that are found too defective are cancelled by stamping a hole in them. These canceled notes pass from one official to another, and are grouped in classified bundles; the book that records the birth of each note now receives a notification of its civil death, and after three years incarceration in a great oak chest, a grand conflagration takes place. A huge fire is kindled in an open court; the defunct notes are thrown into a sort of revolving wire-cage over the fire; the cage is kept rotating; and the minute fragments of ash, whirled out of the cage through the meshes, take their flight into infinite space—no one knows whither. The Bank of France prints a certain number of notes per day, and destroys a smaller number, so as to have always in reserve a sufficient supply of new notes to meet any emergency; but the actual burning, the grand flare-up takes place only about once a month, when perhaps 150,000 will be burned at once. The French go down to lower denominations than the Bank of England, having notes of 100 francs and 50 francs, equivalent to £4 and £2. There must be a great deal of printing always going on in the Bank of France, seeing that in 1868 they issued 2,711 000 notes, of an aggregate value of 904,750,000 francs (averaging about £13 each), and burned 1,927,192, value 768,854,900 francs.

It *sounds* a very dreadful thing for 30,000,000 sterling in bank notes to be willfully burned in one year. But there is always a phœnix to rise from its ashes; the bank can regenerate as fast as it kills. The Bank of France, in 1846, put in circulation a beautiful crimson printed note for 5,000 francs; but the French people did not like notes of so high a denomination, and all but a very few of this kind have been returned and canceled. On one occasion, a superb individual, wishing to pay a dowry in handsome style, obtained twelve notes of 5,000 francs each for the purpose; but they were returned the very next day by the banker, who much preferred smaller notes for his general purposes. The notes now regularly kept in circulation in France are those of 1,000, 500, 100, and 50 francs.

WHAT THE NEWSPAPERS SAY.

A VALUABLE PAPER.—Of all the journals published in the United States, for the mechanic and scientific man, there is nothing that will in any way compare with the SCIENTIFIC AMERICAN, published by Munn & Co., of 37 Park Row, New York. Whether as a work of reference, a record of current scientific development, or as an organ and exponent of our inventors, it stands alone for the general ability of its conduct, the voluminousness and variety of its contents, the exactitude and extent of its knowledge, and the correctness of its information. The SCIENTIFIC AMERICAN is a credit at once to the press and our country, and the small price of a yearly subscription ($3), purchases, it is quite safe to say, the largest amount of solid value to be procured for a like expenditure in the world. With our more intelligent mechanics it has long been a great favorite, while to the inventor it is absolutely indispensable. It has had many imitators and competitors in its day, but they have nearly all died the natural death of a feeble inferiority.—*Argus* (Brooklyn, N. Y.)

THE GREAT JOURNAL OF ARTS AND SCIENCE.—There is a place in the periodical literature of America which is occupied by only one journal; namely, the well-known SCIENTIFIC AMERICAN.

It is almost indispensable to a well-balanced intelligence, that a certain proportion of its reading should be devoted to the industrial arts and sciences, those natural manifestations of the high mental development of the age. Every number of the journal has sixteen imperial pages, embellished with engravings, as illustrations, which are gems of art in themselves. It is most ably edited, and its usefulness is not impaired by technical terms nor dry details.—*Milwaukee Sentinel*

THE SCIENTIFIC AMERICAN.—This paper is the oldest in its peculiar province in the United States, and was, for many years, the only one. More recently others have arisen, and are following in its footsteps; but the SCIENTIFIC AMERICAN still maintains its position as the best American journal of the inventive arts. Its Patent Office department alone is invaluable to inventors, while its editorial articles, illustrations, etc., give not only information, but a constant stimulus to the productive faculty.—*Mobile Register.*

AMONG the papers which we could not very well do without is the SCIENTIFIC AMERICAN, issued from the well-known office of Munn & Co., 37 Park Row, New York. Carefully edited, nicely printed, well illustrated, it is not only a complete record of the progress of useful inventions, but a trustworthy guide to many of the scientific topics that enlist attention at the present day. No one can be a reader of this most valuable journal, without being kept well informed as to current matters of scientific discovery.—*Congregationalist* (Boston).

THE SCIENTIFIC AMERICAN.—In another column we publish the prospectus of this great paper, and would direct our readers to it. It should be on the work bench of every mechanic, and particularly the young men of our country, upon whose intelligence and mechanical skill depends the future dignity of labor and prosperity of American arts and sciences. —*Monitor* (Huntington, Pa.)

We could fill our pages with similar notices, but will close with the following from our cotemporary *De Hope*, published at Holland, Mich., which we doubt not will be read with interest:

Wij plaatsen in dit Nummer het prospectus van den SCIENTIFIC AMERICAN. Het is een zeer schoon blad, dat vooral behoort gelezen te worden door Handwerksliedien. Nieuwe uitvindingen, verbeteringen op het terrein van werktuigkunde, enz, worden daar steeds in vermeld en beschreven. De prijs is zeer matig voor zulk een blad; drie dollars per jaar. Dat belangstellenden de advertentie lezen.

Chinese Methods of Preserving Eggs.

As much has been said of late about the mode of preserving eggs, it may not be uninteresting to say a few words about the Chinese methods, as related by a French chemist, M. Paul Champion, who has lately visited that country, and published a very interesting book on the ancient and modern industrics of that curious people. A very common method is to place the eggs in a mixture of clay and water; the clay hardens around the eggs, and is said to preserve them good for a considerable time. But another and much more elaborate method is also commonly practiced. An infusion of three pounds of tea is made in boiling water, and to this are added three pounds of quicklime (or seven pounds when the operation is performed in winter), nine pounds of sea-salt, and seven pounds of ashes of burnt oak finely powdered. This is all well mixed together into a smooth paste by means of a wooden spatula, and then each egg is covered with it by hand, gloves being worn to prevent the corrosive action of the lime on the hands. When the eggs are all covered with the mixture, they are rolled in a mass of straw ashes, and then placed in baskets with balls of rice—boiled, we presume—to keep the eggs from touching each other. About 100 to 150 eggs are placed in one basket. In about three months the whole becomes hardened into a crust, and then the eggs are sent to market; the retail price of such eggs is generally less than a penny each. These eggs are highly esteemed in China, and always served in good houses; but they have undergone a strange transformation, which certainly would not recommend them to English palates; the yolk has assumed a decidedly green tinge, and the white is set. When broken, they emit that unpleasant sulphurous smell which would certainly cause their instant banishment from our breakfast-tables. However, the Chinese are admitted, even by Frenchmen, to be great *gourmets*; and we can only say, therefore, that in questions of eating there is certainly no disputing about tastes.

Steam Boiler Inspection.

Mr. Alfred Guthrie, U. S. Inspector, informs us that the following resolution was recently adopted by the Board of Supervising Inspectors:

Resolved, That a special committee be appointed, to whom shall be referred the subject-matter of steam boiler explosions, who shall be requested to take up the subject in all its varied complications, and present the result of their inquiries, with their opinions of the real causes of such explosions, accompanied by such information as may be of practical benefit and general interest, to be reported at the next annual meeting of the board for its consideration.

Mr. Guthrie, whose address will be at Washington, D. C. until January 10, desires to receive suggestions from practical engineers upon the subject of boiler explosions.

Editorial Summary.

DARKNESS of complexion has been attributed to the sun's power from the age of Solomon to this day. "Look not upon me because I am black, because the sun hath looked upon me." And there cannot be a doubt that, to a certain degree, the opinion is well founded—the invisible rays in the solar beams, which change vegetable color, and have been employed with such remarkable effect on the daguerreotype, act upon every substance on which they fall, producing mysterious and wonderful changes in their molecular state, man not excepted.

THE three companies under whose protection Chinese are brought into California, keep an accurate account of the condition and employment of the persons they import. From these books it appears that 128,000 Chinese have been brought into California. Of these, 10,426 have died, 57,393 have returned to China, and about 91,000 still remain on the Pacific coast. But only 41,000 live in California. Of these 41,000, 9,300 are women, children, old and decrepit, or criminals confined in the jails. The California authorities have at length decided to admit Chinese testimony in the courts.

ONE of our subscribers residing in Maine has read our article "How to Spend the Winter Evenings," and writes to us that up in his section they have no trouble on that score. As soon as the day's work is over the inhabitants commence the job of trying to get their rooms warm, and as soon as a comfortable temperature is reached it is time to go to bed.

DESIGN PATENT DECISION.—We publish elsewhere a recent elaborate decision of Commissioner Fisher, in which he reviews the laws and former practice of the office in regard to applications for patents for designs, with the view to the establishment of a uniformity of practice in regard to design patents. The decision is one of much interest to inventors and agents, and fully warrants its publication.

A MECHANICS' FAIR.—George Wood, proprietor of Wood's Museum in this city, advertises in another column that he has fitted up extensive apartments, furnished with steam power, for the purpose of exposing for trial and sale the useful inventions of the country; thus affording a good opportunity for inventors to exhibit their machines.

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OUR NEW PAPER CURRENCY.

In July, 1865, letters patent were issued, through the Scientific American Patent Agency, to Jas. M. Willcox, bank note paper manufacturer near Philadelphia, for an improvement in paper, to prevent counterfeiting. As this peculiar paper has been adopted by the Treasury Department for United States securities, and reaches the hand of everybody in the shape of greenbacks, a few words in explanation will be useful to all handlers of money.

Protection in paper, as in engraving, consists in *peculiarity* and in difficulty of imitation; nothing else. Many years ago bank-note paper was made peculiar by the mixing of red, blue, and other colored silk shreds in the pulp before converting it into sheets of paper. This peculiarity was considered a test of genuineness, and was so to a certain extent. Paper made in that way, however, came into the open market, and could be bought by counterfeiters as well as by bank officers and engravers. Mr. Willcox has added a new feature in the introduction of colored shreds, which makes a paper so peculiar that it cannot be made by hand process, or by cylinder machine, but only by the better class or Fourdrinier machine. Even here special machinery is required to *locate* the colored shreds in certain parts of the notes and not in others.

As this machinery exists only in his own mill, and the process is protected by patent, the paper is kept out of the market, and the Government and the public have the advantage of its exclusiveness. The mill is guarded night and day by an armed force in the pay of the Government, to prevent robbery, and there is every reason to believe that this paper will be kept out of unlawful hands.

It will be observed that a line of blue shreds cross the *left-hand* end of all legal tender notes (new issue) of the denominations of one, two, five, and ten dollars; and a similar line crosses the *right-hand* end of all notes above ten dollars. As these lines are in grain, and cannot be altered, the alteration of a low note to a high one would be at once detected by the position of the localized shreds. As these shreds are interwoven with the fibers of the paper, care should be used to make sure that they are neither entirely *under the surface* nor entirely *on the surface*, but *both*.

In the U. S. currency a double process is carried out. In the first place a red fiber is mixed indiscriminately through the pulp, and consequently through the sheet. This is done in the grinding engine.

A second process (with special machinery) is carried out in the Fourdrinier paper machine by the localizing of a *blue* fiber as the pulp is changed into paper. All is interwoven together, and when the sheets are cut into notes the blue fibers find their position as described.

The new fifty cent note which the Department is preparing to issue, will be upon paper of this description; the localized blue fibers occupying one end only of the notes, while all the remainder will have the indiscriminate red. The double process of manufacture will be shown and the exclusive feature will be prominent.

The thanks of the community are due to the Secretary of the Treasury for his earnest and well-directed efforts to protect them from counterfeits; and their attention is called to a proper understanding of this new feature in protection.

As it has been placed under the guardianship of the Department, it is believed to be effectual, and we are glad to have had an agency in bringing it into use.

ISINGLASS GLUE.—Dissolve isinglass in water and strain through coarse linen, and then add a little spirits of wine. Evaporate it to such a consistency that when cold it will be dry and hard. This will hold stronger than common glue, and is much preferred.

SUPPLEMENTARY REPORT OF THE MASSACHUSETTS RAILROAD COMMISSIONERS ON STEEL RAILS.

A report supplementary to the annual report of the Massachusetts Railroad Commissioners, upon the subject of steel rails, has been presented to the legislature of that State. The information embodied in the report was obtained in answer to questions, printed in circular form, and sent to the officers of the several railroads throughout the country. The circular embraced twenty-one queries relative to the time steel rails were first employed on the respective roads, the extent to which they have been used, their weight per yard, the conditions under which they have been used, their relative cost as compared to iron, and the general results of experience in their use.

Replies to these inquiries were received from 57 roads, twenty of which have made no trial of steel rails; others have tried only a few by way of experiment, and find them, so far, greatly superior in durability to iron rails in similar situations. Twenty-six roads have laid steel rails in amounts varying from 100 tuns to 15,000 tuns and their reports are generally very much in favor of steel rails, particularly, for heavy service.

The names of the roads and the amounts of steel rails they have laid are respectively as follows:

Eastern Railroad, Mass., 410 tuns, about four miles. Weight of rail 56 and 60 lbs. to the yard. Boston and Maine Railroad, Mass., 100 tuns; 60 lbs. to the yard. Boston and Albany, Mass., 1200 tuns, 57 to 62 lbs. to the yard. Boston and Providence, Mass, 1400 tuns, 52 to 62¼ lbs. Old Colony and Newport, Mass., 135 tuns, 55 and 60 lbs. to the yard. Vermont Central, 100 tuns, 60 lbs. Connecticut River Railroad, 405 tuns, 56 to 60 lbs. New York and New Haven, 5,500 tuns, 62 lbs. to the yard. Erie Railway, 8,509 tuns, 56 to 62¼ lbs. Camden and Amboy, N. J., 1,500 tuns, 56 lbs. North Pennsylvania, 400 tuns, weight of the rails per yard not given. Philadelphia, Germantown, and Norristown, Pa., 350 tuns, 60 lbs. to the yard. Northern Central, of Pa., 300 tuns, 60 lbs. Lehigh and Susquehanna, Pa., 5,100 tuns, 60 lbs. to the yard. Philadelphia and Reading, Pa., 800 tuns, 60 to 64 lbs. Philadelphia, Wilmington, and Baltimore, 3,110 tuns, a small portion 51, but the rest 56 to 58 lbs. Pennsylvania Railroad, 14,794 tuns, 56 to 67 lbs. to the yard. Pittsburgh, Fort Wayne, and Chicago, Ohio, 400 tuns, 60 lbs. Toledo, Wabash, and Western, Ohio, five miles, 60 lbs. to the yard. Cincinnati, Hamilton, and Dayton, Ohio, 400 tuns, 60 lbs. Michigan Central, 298 tuns, 61 lbs. Michigan Southern, two miles, 57 to 62 lbs. to the yard. Chicago and Northwestern, Ill., 1000 tuns, 60 lbs. Chicago, Burlington, and Quincy, Ill., 300 tuns, 66 lbs. Chicago, Rock Island, and Pacific, Ill., 1,600 tuns, 56 and 57 lbs. per yard. Chicago and Alton, 800 tuns, 54 and 60 lbs.

The aggregate of these amounts, added to amounts not communicated by other roads, but ascertained from the report of the State Engineer of New York, and other sources, form the basis of the estimate, that at least 100,000 tuns of steel rails were laid in this country on the first of January, 1870. The conclusions derived from the experience of various railway companies, and given in full in the report may be summed up as follows:

Extremes of temperature do not injuriously affect steel rails. In one case (the Grand Trunk Railway), they have been subjected to a temperature of 30° Fah., without injury. The durability of steel rails far exceeds that of the best iron rails. Two roads, the Erie Railway and the Providence road, report steel rails as having outworn thirteen sets of iron ones; the Chicago and Northwestern, fifteen sets; and the Philadelphia, Wilmington, and Baltimore, *seventeen* sets.

It is also found that heavy grades and sharp curves do not materially affect the wear of the rails. Also, that if the rails be carefully inspected before laying, all flaws and imperfections can usually then be discovered, and that risk to life and property from the breaking of rails may be almost wholly obviated by proper tests, and a small additional expenditure. It seems to be agreed that square notches punched in the base of the rail almost always originate seams or fractures. Some advocate punching the stem of the rail, but the majority favor drilling instead of punching.

The report states that the manufacture of steel-headed rails has made such advances that they are now very serviceable and satisfactory in use, and that their employment is extending, and likely to continue to extend.

It is shown that interest on the investment is a controlling element in the question of the relative economy of iron and steel rails, and the Commissioners seem to incline to Sandberg's estimate, made on the basis of interest at five per cent, which is, that "where ordinary iron rails are worn out in five years or less, solid steel rails are most economical; where they last over ten and up to fifteen years, steel-headed rails would be the cheapest; but if the iron rails will last from fifteen to twenty years, or more, it is cheapest to use them."

The report concludes by stating, that a form of compound rail of two sides ⌊ of iron, with a ⌋ of steel resting upon them, and all three parts bolted together, has been recommended by several parties, and, in the opinion of the Commission, is likely to prove very satisfactory.

PROPORTION OF HEAT UTILIZED IN STEAM ENGINES.

How the proportion of heat utilized in steam engines from the combustion of coal or other fuel is determined, has been a subject of inquiry from some of our correspondents. We shall in the present article endeavor to make this subject as clear as may be, premising, however, that to those not familiar with the elementary laws of heat the subject presents some difficulties. It will therefore first be necessary to refer to some elementary principles.

It has been found that the rise and fall of the thermometer is not an index of the heat contained in different bodies, and that this instrument can only indicate what is called "temperature," a term very distinct from heat. Temperature is a generic name for certain manifestations of heat, which bear no constant relation in different bodies to the absolute amount of heat present. A better term than temperature is *sensible heat*. It is this heat which is indicated by the thermometer. The heat which exists in substances, and which does not act to expand other colder bodies when near to those substances, and which does not produce the sense of warmth in the animal economy, is called latent heat.

In other words, all substances have definite capacities for heat, and may possess a certain amount without that heat being directly perceivable, and it is by making this latent heat appear as sensible heat by transferring it to other bodies with less capacity for heat, or by reducing the capacity of bodies for heat that its existence is determined.

This may be done by chemical action. Put quicklime and water together, and, although both bodies may possess a very low temperature, their latent heat, being converted into sensible heat by the reaction which takes place, will develop a high temperature in the mass.

When air or any other substance is compressed by mechanical action, so that its bulk is diminished, its capacity for heat is diminished, and more or less of its latent heat is converted into sensible heat. When a gaseous body like steam is mixed with a cold body like water, the steam is condensed to water again, and all its latent heat is imparted to water as sensible heat. Latent heat may therefore be rendered sensible either by mechanical or by chemical action, and it is not necessary to specify further the numerous ways in which this may be performed.

It must be borne in mind here that the terms *latent* and *sensible*, applied to heat, do not indicate any difference in essential quality, and it may be added, incidentally, that modern science tends strongly to substantiate the theory that heat is, to use the words of Helmholz, "simply a shivering motion of the ultimate particles of bodies."

We have seen that the thermometer does not indicate the total heat contained in bodies. Thus a pound of steam at atmospheric pressure and a pound of boiling water affects the thermometer equally, the mercury rising to 212° Fah.; but 5·3144 pounds of water at 32° Fah. may be mixed with this steam, making 6·3144 pounds of water at 212°. Here the thermometer has stood at 212° during the entire experiment. It is evident, therefore, that the heat which has raised the temperature of the 5·3144 pounds of water from 32° to 212° was not at any time indicated by the thermometer.

A degree of the thermometer is not therefore a unit of heat.

It has been agreed to consider the amount of heat that will raise a pound of water one degree Fahrenheit, as the unit of heat. Experiment has shown this to be nearly a constant, at least sufficiently so for practical purposes. The heat developed by combustion may then be estimated by multiplying the weight in pounds of a mass of water into the number of degrees the temperature of the mass has been raised by the heat developed.

The experiments of Fabre and Silbermann were perhaps the most accurate ever performed to ascertain the total heat developed by the combustion of various substances.

The apparatus employed was a vessel of brass, gilt, and immersed in a vessel of silvered copper, containing about three and one half pints of water. This copper vessel was surrounded by a case filled with swan's down, to prevent loss by radiation, and this case was in turn surrounded by water in an outer chamber, so that even the small amount of heat that traversed the layer of swan's down should be intercepted. By these means it was found that the amount of heat absorbed by the atmosphere was reduced to a very small and measurable quantity.

The combustibles experimented upon were placed in the interior brass chamber, and were burned in pure oxygen previously dried and conveyed to the chamber through a tube, and the gases of combustion were made to traverse a spiral tube in the water until their temperatures were lowered to that of the water. Small pieces of lighted charcoal were used to ignite solid bodies, and liquids were burned in lamps with wicks of asbestos. Gases were introduced through jets previously lighted.

In this way the heat generated by the combustion of a large number of bodies was determined and tabulated.

The experiments of Joule have shown that the actual amount of heat developed by friction is dependent simply upon the force expended in producing the friction, and conversely it has been determined that the heat actually expended in performing a given amount of work is exactly proportional to the amount of work performed.

Joule has shown that raising the temperature of one pound of water one degree is equal to the mechanical power generated by the fall of a body weighing 772 pounds through one foot of space. This amount of work is called the *mechanical equivalent* of heat.

It will be evident now, that, knowing the amount of heat produced by a given weight of any kind of fuel, and the work performed by a steam engine under the boiler of which the combustion has been performed, that by comparing the actual work performed as measured by the dynamometer, with the total work the heat generated is capable of performing, as determined by the mechanical equivalent of heat, the percentage of heat converted into work by the engine may be also determined. On the average it is probable that this does not exceed ten per cent.

Playfair and De la Bèche found 18,873 units of heat to be the mean total per pound of seventeen different kinds of

HABITS OF THE STRIPED SQUIRREL---A WHITE WOODCHUCK.

Mr. Ira Sayles, of Rushford, N. Y., writes to the *American Naturalist* as follows:

"I lately noticed in my garden a bright-eyed chipmunk, *Sciurus striatus*, advancing along a line directly towards me. He came briskly forward, without deviating a hair's breadth to the right or the left, till within two feet of me; then turned square towards my left—his right—and went about three feet or less. Here he paused a moment and gave a sharp look all around him, as if to detect any lurking spy on his movements. (His distended cheeks revealed his business; he had been out foraging). He now put his nose to the ground, and, aiding this member with both forepaws, thrust his head and shoulders down through the soft muck, half burying himself in an instant.

"At first, I thought him after the bulb of an *erythronium*, that grew directly in front of his face and about three inches from it. I was the more confirmed in this supposition, by the shaking of the plant.

"Presently, however, he became comparatively quiet. In this state he remained, possibly, half a minute. He then commenced a vigorous action, as if digging deeper; but I noticed that he did not get deeper; on the contrary, he was gradually backing out. I was surprised that, in all his apparent hard work (he worked like a man on a wager) he threw back no dirt. But this vigorous labor could not last long. He was very soon completely above ground; and then became manifest the object of his earnest work; he was refilling the hole he had made, and repacking the dirt and leaves he had disturbed. Nor was he content with simply refilling and repacking the hole. With his two little handlike feet he patted the surface, and so exactly *replaced the leaves* that, when he had completed his task, my eye could not detect the slightest difference between the surface he had so cunningly manipulated, and that surrounding it. Having completed his task, he raised himself into a sitting posture, looked with a very satisfied air, and then silently dodged off into a bush-heap, some ten feet distant. Here, he ventured to stop, and so, up a triumphant "chip! chip! chip!"

"It was now my turn to dig, in order to discover the little miser's treasures. I gently removed enough of the leaves and fine muck to expose his hoard—half a pint of buttercup seeds, *Ranunculus acris*. I took out a dozen seeds or so, recovered the treasure as well as my bungling hands could, and withdrew filled with astonishment at the exhibition of the cunning, skill, and instinct of this little abused denizen of our field-borders.

"In my boyhood days I had killed many of the little fellows; had unearthed the treasures in their burrows many times; had seen them, as I supposed, under every variety of aspect; in short, I thought I knew the chipmunk, every inch; but here was a new revelation of chipmunk character, for which I was totally unprepared.

"It grieves me that I find it utterly impossible with words to convey adequately to you and your readers anything like a complete picture of the motions, the skill, the carefulness, the completeness of effect, and the consequent satisfaction exhibited by this little harvester. I have never read or heard of any other man's having witnessed a similar scene, nor do I expect myself ever again to witness one. My opportunity for observation was as perfect as it could possibly be; for he was so near me that I could almost stoop over and lay my hand on him, while he was half buried under the leaves.

"The lesson is perfect; for what our chipmunk does, all chipmunks do, under the same circumstances. Where does instinct stop, and reason begin? Wherein does instinctive, *irrational* skill differ from rational skill?"

Mr. S. Tenney, of Williams College, writes to the same journal:

"It may interest you and some of your readers to know that I have obtained a perfectly white woodchuck, a perfect albino of *Arctomys monax* of Gmelin. There is not a dark hair on his body or tail, and his eyes are of a clear, rich, carnelian color. He was caught on Northwest hill, Williamstown, Mass., and brought to me alive. From the first he fed freely on clover, especially the clover heads, and made a nice nest for himself from the part discarded as food; in this nest he spent most of his time, taking nearly the form of a ball. He always exhibited a readiness to bite, and it was not safe to touch him with the hand. One day I carried him, in his small cage, to my lecture room, and afterwards put him in my private room and left him alone. When I returned I found him out of the box or cage, and bottles and trays of natural history specimens scattered upon the floor. After disturbing things generally he had taken up his position behind a large box of fossils. From his retreat he looked as unconcerned as if nothing had happened. Without much trouble I secured him in his box again, and carried him home and put him in a large cage in my cellar, which is well lighted and ventilated. About midway between the top and bottom of this cage is a shelf which touches the bars or slats in front, and extends backwards about half the depth of the cage. This shelf was put in so that the woodchuck might have something to rest upon besides the floor of the cage. After the cage was done it was desired to turn it so that what is naturally the back should be the bottom, the slats or bars thus being on the top instead of at the side; this brought the shelf into a vertical instead of a horizontal position. Now observe what this woodchuck did: he gnawed through the edge of this shelf, which was against the bars, in order to get into the other part of his cage, although there was a space of eight or ten inches below the lower edge of the vertical shelf for the whole width of the cage, and when he was disturbed he often run through this hole instead of going along on the bottom.

"I was interested to see that he used everything he could get to enlarge and perfect his nest, not only all of his discarded clover stalks, and the rags which I gave him, but also all the chips which he gnawed from his cage. But he did not get thoroughly tamed, and so availing himself of the absence of a board, which had covered a hole which he had been gnawing, he squeezed out through the hole, scaled the cellar wall, and escaped through an open cellar window. A few weeks afterwards he was killed by a farmer's dog, and I have sent his skin to Mr. Jillson to be mounted.

"Mr. Hitchcock, of this town, informs me that he has seen a living white woodchuck in New Lebanon, N. Y."

ANCIENT AND MODERN COINAGE.

Platinum was coined in Russia from 1828 to 1845. But the metals best adapted and most generally used as coin, are copper, nickel, silver, and gold; the first two being now used for coins of small value, to make change, the two latter, commonly designated "the precious metals," as measures of value and legal tender. On the continent of Europe a composition of silver and copper, called billon, has long been used for small coins; which are made current at a much higher value than that of the metals they contain. In China Sysee, silver is the principal currency, which is merely ingot silver of a uniform fineness, paid and received by weight.

Spanish and Mexican dollars also circulate there, but only after they had been assayed and stamped as proof that they are of the standard fineness. As Asia Minor produced gold, its earliest coinage was of that metal. Italy and Sicily possessing copper, bronze was first coined there.

The Lydians had gold coins at the close of the ninth century B. C.; Greece proper only at the close of the eighth century B. C. Servius Tullius, King of Rome, made the pound weight of copper current money.

The Romans first coined silver 281 B. C., and gold 207 B. C. Some nations, although they worked the metals with skill, seem never to have coined money, and such was the case with the Irish, of whom no coins are known prior to the English invasion in the twelfth century.

The amount of specie existing in Europe, A. D. 14, was equal in value to but £358.

After the Augustan era the product of the European mines failed, and the stock of coin gradually disappeared until the ninth century, each step of its fall being marked by the greater poverty and social degradation of the people, until at last such was the scarcity of coin, *human beings* in Britain were made a legal tender at specified rates.

INVENTION OF BANK NOTES.

This dearth of the precious metals contributed largely toward establishing the dark ages. Out of these depths arose the great modern institutions—the mercantile theory and credit—the one a palliative and the other a cure. No increase in the stock of coin occurred until after the discovery of America, but the invention of paper credit largely alleviated the prevailing misery. This invention is due to the Jews, who, in 1160, introduced bills of exchange, and who were the only persons, from the institution of the canon law against the taking of interest for the loans of money to the sixteenth century, who, in Western Europe, durst make a business of giving credit.

The same people established the first banks in Europe. That of Venice was established in 1157, that of Geneva in 1345, that of Barcelona in 1401, and that of Genoa in 1407. The discovery of America in 1492, produced no immediate increase in the European stock of coin. The mines of Potosi were opened in 1545, but it was not until near the seventeenth century that the stock of coin sensibly increased. The taking of interest was totally forbidden in England until 1571, and the device of extending credit by means of indorsement was not practiced until a century later, when it was introduced from Holland.

INCREASE OF COIN.

The stock of coin steadily increased until 1827, when it reached its highest point, and then declined until the opening of the Pacific coast mines in 1848, when it again increased, passing in 1860 its greatest previous hight, and obtaining in 1867 the enormous sum of two thousand six hundred millions of dollars.

Copper coins, few in number, were used by the Mint of the United States as early as 1792; but these are now so rare that one of them sold at auction in Philadelphia, in January, 1860, for sixty-five dollars and fifty cents, and another for fifty dollars. The Mint did not get fairly into operation until 1793, when the first copper cent appeared.

The estimated amount of gold in existence at the commencement of the Christian era was $427,000,000. At the discovery of America, in 1492, this amount had diminished to $57,000,000. In 1600 the amount had risen to $105,000,000; in 1700 to $351,000,000; in 1800 to $1,251,000,000. The Russian mines extending over one third of the surface of the globe, on parallel fifty degrees north latitude, were discovered in 1819.

In 1843, the estimated amount of gold in existence was $2,000,000,000.

Next followed the discoveries in California, February 9th, 1848, and in Australia, February 12th, 1851, which added enormously to the gold production. In 1853, the amount in existence was computed at $3,000,000,000; and in 1860 it was $4,000,000,000.

From the commencement of the Christian era to the discovery of America, it was estimated that gold had been taken from the surface, and mined to the amount of $3,800,000,000. From that date to the close of 1842, $2,800,000,000; to 1860, Russia adds $746,000,000 and California and Australia, $2,000,000,000 more. The amount of gold at present in existence is estimated at $5,950,000,000. The quantity of gold and silver, of all denominations, in all quarters of the globe, is set down, by the best authorities, at from three to four hundred millions pounds sterling; and the quantity of plate and ornaments at about $400,000,000.

WHAT BECOMES OF THE COIN.

In the reign of Darius gold was thirteen times more valuable, weight for weight, than silver. In the time of Plato it was twelve times as valuable. In that of Julius Cæsar gold was only nine times more valuable, owing, perhaps to the enormous quantities of gold seized by him in his wars. It is a natural question to ask, what became of the gold and silver? A paper read before the Polytechnic Association by Dr. Stephens, recently, is calculated to meet this inquiry. He says, of our annual gold product, full fifteen per cent is molted down for manufacture; thirty-five per cent goes to Europe; twenty-five per cent to Cuba; fifteen per cent to Brazil; five per cent direct to Japan, China, and the Indies; leaving but five per cent for circulation in this country. Of that which goes to Cuba, the West Indies, Brazil, full fifty per cent finds its way to Europe, where, after deducting a large percentage used in manufacturing, four fifths of the remainder is exported to India. Here the transit of the precious metal is at an end. Here the supply, however vast, is absorbed, and never returns to the civilized world.

The Orientals consume but little, while their productions have ever been in demand among the Western nations. As mere recipients, therefore, these nations have acquired the desire of accumulation and hoarding, a passion common alike to all classes among the Egyptians, Indians, Chinese, and Persians. A French economist states that in his opinion the former nation alone hide away $20,000,000 of gold and silver annually, and the present Emperor of Morocco is reported as so addicted to this avaricious mania that he has filled seventeen large chambers with the precious metals. The passion of princes, it is not surprising that the same spirit is shared by their subjects, and it is in this predilection that we discover the solution of the problem as to the ultimate disposition of the precious metals. This absorption by the Eastern nations has been uninterruptedly going on since the most remote historical period. According to Pliny, as much as $100,000,000, in gold, was, in his days, annually exported to the East. The balance of trade in favor of those nations is now given as $80,000,000.

A system of international coinage is proposed, and a congress has recently been held in Paris, at which the several nationalities were represented, including the United States.

If our Government shall indorse the proposed system, there will be a national change in our coinage, if we shall ever return to hard money times. The proposed standard of coinage—the *franc*—is equal in value to about nineteen and one fifth cents. A five franc piece is accordingly worth four cents less than the American dollar, which is our present standard of coinage. Under the proposed plan, our present half-dollar would be represented by a piece worth forty-eight cents, etc.

The ancient English penny was the first silver coin struck in England. It was equal in weight to the present three-penny piece.—*Christian Union.*

Faraday in Private Life.

About 1823, when my uncle Faraday was studying elocution under Smart, he took great trouble to teach me, a little girl of seven, to read with good emphasis, and I well remember how unweariedly he would go over and over one sentence, and make me repeat it with the upward and downward inflections, till he was satisfied; and then perhaps would follow a good romp, which pleased the little girl much better than elocution.

My uncle read aloud delightfully. Sometimes he gave us one of Shakespeare's plays or Scott's novels. But of all things I used to like to hear him read "Childe Harold;" and never shall I forget the way in which he read the description of the storm on Lake Leman. He took great pleasure in Byron, and Coleridge's "Hymn to Mont Blanc" delighted him. When anything touched his feelings as he read—and it happened not unfrequently—he would show it not only in his voice, but by tears in his eyes also.

Nothing vexed him more than any kind of subterfuge or prevarication, or glossing over things. Once I told him of a professor, previously of high repute, who had been found abstracting some manuscript from a library. He instantly said—"What do you mean by abstracting? You should say stealing; use the right word, my dear."

If he gave me my choice in anything, he could not bear indecision, and I had not only to decide, but to decide quickly. He thought that in trifles quickness of decision was important, and a bad decision was better than none. When my uncle left his study and came into the sitting-room, he would enter into all the nonsense that was going on as heartily as any one, and, as we sat round the fire, he would often play some childish game, at which he was usually the best performer; or he would take a part in a charade, and I well recollect his being dressed up to act the villain, and very fierce he looked. Another time I recollect him as the learned pig. In times of grief or distress his sympathy was always quick, and no scientific occupation ever prevented him from sharing personally in all our sorrows, and comforting us in every way in his power. Time, thoughts, purse—everything was freely given to those who had need of them.—*Mrs Reid's Recollections.*

THE first steamboat used in Great Britain was the *Comet*, a small vessel of forty feet keel, and ten feet and a half beam, with an engine of three-horse power, which carried passengers on the river Clyde, Scotland, in 1814.

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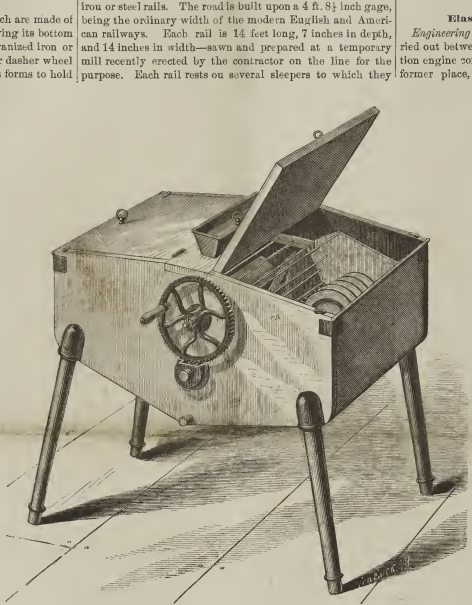
Improved Dish-Washing Machine.

Machines for washing dishes, which can do this work well and rapidly, are a *desideratum* for hotels, restaurants, large boarding-houses, hospitals, asylums, as well as for private families. The one of which the annexed engraving is a perspective view, is extremely simple, and it is claimed does its work in a perfect and rapid manner.

It consists of a trunk or box, the sides of which are made of wood or sheet metal of a suitable kind, and having its bottom and ends formed of a continuous sheet of galvanized iron or other suitable metal, and containing a water or dasher wheel of peculiar construction, with racks of various forms to hold the dishes to be washed, the racks being made of galvanized iron wire, and so constructed and placed as to sustain in the proper position for cleansing any and all of the various dishes in modern use.

The efficiency of the machine depends chiefly on the form of the dasher wheel. This wheel is made one wing at a time, so that the wings, four in number, each have the form of portions of the shell of a frustum of a cone. These are placed in pairs, their concavity outward, so that the apex of one pair is opposite the base of the other. As a consequence of this construction and proper attention to the proportioning of the wheel, it follows that in rotating it by means of the winch, gear, and pinion, the water will be thrown forcibly toward one side of the trunk or box, and in reversing the motion it will be as forcibly thrown toward the other side, so that both sides of plates or other dishes may be acted upon as described below.

In use the dishes are placed in the trunk on the proper wire racks, and the lids are shut and buttoned down. Hot water, with or without soap as may be necessary, is then introduced through a hopper-shaped strainer trough at the top of the machine. Four or five quarts of boiling water and a tablespoonful of soft soap, or its equivalent of hard soap, is sufficient. The crank is then turned to the right and left alternately for from two to three minutes. The water is then drawn off, and about the same amount of rinsing water is poured in, and the dashing is repeated. The covers are then opened, and the dishes being hot will dry in a few minutes. The drying may be, if desired, accelerated by turning the dasher wheel, which forces a current of air over the dishes. This invention is the device of an Illinois lady, and it is another proof that the female sex is not without its share of inventive talent.



CLARKE'S DISH WASHER.

Patented, Dec. 7, 1869, by T. D. Clark, whom address for urther informaton at Xenia, Ill.

How Counterfeit Notes are Made.

A party of men, say from three to a dozen, get together and hold frequent meetings, and act according to a plan laid down. One or two will find out some copper-plate printer in the employ of the bank note company—in fact all such printers are known by the party. These men will then manage to meet one of the printers in the evening, get acquainted, drink, and have a good time generally with him, and so proceed for a few evenings. Then they offer him from $50 to $100 to procure a certain kind of impression. This impression is made in this wise: The printer will take the impression upon tin foil from the plate from which he is printing, which can be done in a moment. Thus you see every line and the size is obtained correctly. From this tin foil an electrotype plate is made. They then get some plate printer that can be found about the city, have a good time with him, and engage him at twenty dollars a day to do the printing. By this plan thousands of copies are struck off that defy detection, except in the quality of the paper, which will differ from the genuine. The place of manufacture is generally at some distance from New York, like Staten Island, Flatbush, or sometimes Baxter street or some similar locality in this city. It is a strange fact in every case where a party of this kind exists, that every member lacks confidence in his associates. Every move made by one is narrowly watched by the others of the party. It would be death to an informant or spy that did not look well to himself.

A Wooden Railroad.

A railroad with rails of wood has recently been built from Quebec through the village of Jacques Cartier, about fifteen miles. The Quebec *Chronicle* speaks of it as follows:

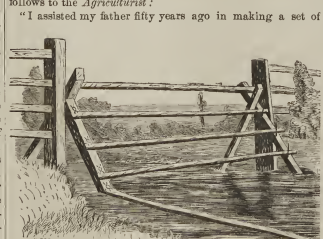
"The problem of wooden railways for colonization purposes may now be said to be solved, and as a proof of it, it is necessary to say that we passed over the road yesterday, at a rate of from twenty to thirty miles an hour, a speed which is seldom passed on any of the iron roads in this Province. The cars conveying the party yesterday were simply rudimentary vehicles, known as platform carriages, but sufficient evidence was given that the line when completed will be as easy and smooth for traveling purposes as upon the old established iron or steel rails. The road is built upon a 4 ft. 8½ inch gage, being the ordinary width of the modern English and American railways. Each rail is 14 feet long, 7 inches in depth, and 14 inches in width—sawn and prepared at a temporary mill recently erected by the contractor on the line for the purpose. Each rail rests on several sleepers to which they are fastened by wedges—by a process so simple that the rail when required, can be removed or reversed by any ordinary mechanic. The locomotive is from the Rhode Island Iron Works, and is most assuredly a splendid piece of mechanical ingenuity, while it is supposed to weigh 31 tuns, loaded, without the tender."

[Will the *Chronicle* inform us as to the cost of the above road per mile.—EDS.

Flood Fence.

Mr. Asa Hartshorn, of Ashtabula county, Ohio, writes as follows to the *Agriculturist:*

"I assisted my father fifty years ago in making a set of



bars, as shown in the cut, in New London, Conn., and they remained good thirty years or more. The posts, or crotches, should be fastened firmly by stones, or be set well into the bank of the stream. Two staples and one link are required to each bar. These should be made of ¾-inch iron. The other ends of the bars rest on ¾-inch pins. In time of a flood one or more of the bars may float up and swing around down stream, and when the water subsides, they may be returned to their places.

"These floating bars have the advantage over any other gate, as they open, and let all flood-wood and trash pass. I am an old man, and have whittled it out, so you can see how it should be on the stream. The round top pole rests in the crotch of the posts above high water, and in this way any stream twenty-five feet wide can be fenced with safety."

Elastic Tires for Traction Engines.

Engineering states that an interesting trial was recently carried out between Rochester and Chatham of a five-horse traction engine constructed by Messrs. Aveling & Porter, of the former place, and fitted with tires formed of india-rubber segments attached to iron plates by a process patented by Messrs. L. Sterne & Co., Great Queen street, Westminster, these plates being bolted to the wheel tire and further secured by iron rings. The front pair of driving wheels of the engine are 3 ft. 6 in. in diameter, and are fitted with indiarubber segments 12 in. long, 4 in. wide, and 3 in. thick. The rear pair of driving wheels are 5 ft. in diameter, and are fitted with india-rubber segments 12 in. long, 6 in. wide, and 3 in. thick. The rubber is firmly attached to ¼ in. steel plates, which are bolted on to the ¼ in. wrought-iron tires, the segments being still further secured by ⅜ in. wrought-iron rings placed on each side of the wheel.

The trial, which was conducted by Messrs. Aveling & Porter, took place on Friday last in the presence of a number of Government officials, and some of our leading engineers. The engine started from Messrs. Aveling's works, at Rochester, with two long four-wheel lorries and a load of iron girders, giving a total weight of about 12 tuns. It proceeded at a pace of about 4 miles an hour through the slippery streets of Rochester, travelling steadily up Star hill, which has a gradient of 1 in 12 for more than 300 yards. It made several sharp turnings round corners, the radius of the path of travel being not more than 15 ft. With one ordinary iron skid on the rear wheel of the hindmost lorrie, it descended Rome-lane—a steep falling grade—under complete control. The rough and irregular stone causeway, the timber bridgeway of the Chatham Dockyard, and the rough and broken ground near the landing quay on the Medway were all smoothly and successfully traversed. The girders were landed on the quay, and the engine then returned to Rochester. The ground near the landing quay is full of billocks of cinder, clinker, stone, bricks, scrap iron, etc., but, although the engine ran over all these substances, not a cut nor permanent indent was to be found afterwards in the india-rubber segments.

The great advantage of Messrs. Sterne's method of attaching the india-rubber in segments over the solid ring is, that if a segment gets damaged it is easily and quickly removed and replaced by a spare segment at a moderate cost. The motion of the engine during the run was easy, and the india-rubber readily impressed itself into the inequalities of the roadways. To avoid all possibility of slip in wet streets and on clay soils, Mr. Aveling proposes to introduce steel staples or crossbars, so arranged as to take the traction without neutralizing the benefit derived from the elastic action of the rubber. There is no doubt a decided advantage in Messrs. Sterne's method of utilizing the india-rubber. Traction engines with their wheels thus tired will prove useful under the special local circumstances, such, for instance, as where they have to traverse paved or very uneven roads. But here to our mind, the advantage of rubber tired wheels ceases, and we believe that the engine in question, or, in fact, any of Messrs. Aveling & Porter's engines, would work as well without as with this addition, and that in most cases the 130*l.* or 140*l.* which these appliances cost, could be more profitably expended on the engine in other ways.

We may observe in conclusion, that there is no fear of the rubber parting from the plates to which it is attached by Sterne's process. Its adhesion has been tested by Mr. Kirkaldy, who found that a direct pull of 6,216 lbs., or 177½ lbs. per square inch, was required to separate the two. In compression the rubber segments stood 66½ tuns per square foot, returning to their normal condition after the pressure was removed.

THE quartz miners of California are predicting a long continuance of wet weather. Swallows and martins in Lower California have raised their broods quickly this summer and departed. This phenomenon, it is asserted, is a sure sign of a wet winter. What wonderful meteorologists these little birds must be

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Improved Horse-Power Drilling Machine.

The sinking of wells by drilling, or what is commonly known among engineers as the "Artesian" system, is in many sections the only method of obtaining a permanent supply of pure water. In any locality it offers one important advantage over that of open wells, namely, the exclusion of surface water, which, unless great care and extra cost are expended in their construction, is apt to drain and leach into open wells, and contaminate their waters.

In sinking Artesian wells, or in boring for oil, when anything more than a few feet of earth, or rock, are required to be penetrated, the increasing weight of the drill attachments necessitates the use of greater power than manual labor can supply. In most localities, and for ordinary boring, the power of horses is more conveniently obtained than any other, and the object of the invention of which we give engravings herewith, is to furnish an improved system of applying such power to the purpose specified.

For this device the following advantages are claimed, viz: that it can do a given amount of work with less power than other appliances of the same class hitherto used; that it can be set up anywhere, on uneven ground, or in other circumstances of difficulty, and the horse power may be placed at any reasonable distance from the derrick, say, 200 feet; that it will give any length of stroke, from three inches to three feet; and that it is so easy of transportation, and can be set up with such facility that it may be transported five miles and all its parts adjusted to work the same day.

Fig. 1 is a perspective view of the apparatus, and Fig. 2 is a detail, showing in larger size, and more fully, the parts of the horse power.

MERRILL'S IMPROVED HORSE-POWER DRILLING MACHINE.

The horse is attached to the sweep, A, Fig. 2. This sweep imparts motion to the gear, B, and through it to the pinion, C, and the revolving lever, D. The revolving lever, D, is provided with friction rollers at its extremities, and actuates the lever, E, which, through the connecting rod, F, and chain, actuates the lever, G, Fig. 1. From this lever, G, a chain connects with a rope passing over a pulley at the top of the derrick to the drill, as shown.

Whenever the revolving lever, D, Fig. 2, disengages with the lever, E, the end opposite the lever, E, engages with the friction plate, H, Fig. 2, which affords sufficient resistance to prevent a sudden jerk upon the horse. This plate is provided with strong rubber springs, which, pressing it against the friction rollers on the revolving lever, give the required resistance.

In raising the drill out of the bore, a windlass and rope are employed, as shown in Fig. 1, the end of the rope being fastened at I, when not needed. As farther assistance in raising the drill, when it becomes stuck in the bore, a workman places his feet on the lever, G, and seizing with his hands the bars, J, is enabled to exert a powerful leverage upon the drill, through the rope connecting it with the lever.

We are informed that this machine has already received an extensive application in boring wells, in various sections of the country, and that it is satisfactory in all respects.

Patented, May 4, 1869, through the Scientific American Patent Agency, by C. L. Merrill, whom address for machines or rights, at Watertown, N. Y.

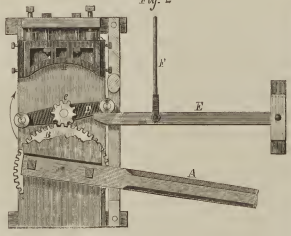
PITTSBURGH has thirty-two iron, nine steel, and two copper mills. The daily consumption of the iron mills is 1,200 tuns, and their annual production $23,000,000. There are forty-eight founderies, employing two thousand men in all, and, adding $5,000,000 per year to the wealth of our country.

CURRENCY OF JAPAN.

[Condensed from the Mechanics' Magazine.]

In Jeddo there were, up to a comparatively recent period, three separate establishments devoted to the production of coin. One of these was appropriated to each of the three metals employed. The gold mint, however, was destroyed by fire a few years since, and it has not been and will not be rebuilt. When in existence, no foreigner was allowed to inspect it, and therefore nothing authoritative can be said of its internal organization. The building, or series of buildings, rather, devoted to the coinage of silver money, is situated in a narrow street in the mercantile quarter of the capital. On entering the silver mint, the eye of the European would be first attracted by the extraordinary positions assumed by the work people. Groups of men were seen in all directions, squatting on the ground and engaged in weighing, hammering, cutting, sorting, and packing the metal. A few officers, controlling the operations and giving instructions, moved about among the squatters. Let us take as an example of the processes carried on in respect of all the denominations of silver coin, the production of the itzebus of that metal. For the sake of simplification of description, we may speak of the past as if it were the present time.

Fig. 2



A massive block of silver of the requisite degree of fineness, as determined by assay, is placed in an iron ladle and reduced to a molten state by aid of a charcoal fire and a pair of blacksmith's bellows. The metal is poured into molds, that shape it into thin, rectangular bars, which are removed as soon as solidified and plunged into cold water. From the bath they are removed and handed one by one to a seated workman, who trims off their ragged edge by means of a pair of shears fixed to the ground. Another workman receives and improves their surfaces by hammering them. A third coiner, prepared with a pair of scales, weighs the bars and divides them into parcels, and a fourth shears them to the requisite length. The next operation is that of shearing the bars into short lengths, equal to that of the coin itself. Each bar yields eight coins. Another series of weighing now commences, and this demands the exercise of considerable skill and care, as it is also a test of the judgment with which the cutter has performed his task. The planchets which are below legal weight have to be returned to the melting ladle. Those which are correct in this respect are passed forward, and those which are too heavy are reduced by aid of shears. All the accepted planchets have next to be annealed and blanched.

These processes are effected by heating the embryo coins to redness over a charcoal fire, plunging them into cold water, and then immersing them in a bath of boiling acid. From this latter the planchets emerge with whitened or frosted surfaces of fine silver, the acid having attacked and dissolved the alloy. They are next planished on both sides by means of a flat-faced hammer. The edges are touched slightly in a similar manner, and thus the blank slips are made ready for stamping.

This operation is simple in the extreme. A workman places a single planchet, with thumb and finger, on a die firmly fixed, and resting on a solid bed. With his right hand he places another die on the top of the silver piece. A sledge hammer, wielded by an assistant, is the coining press.

The hammer, dexterously handled, falls in rapid succession upon the upper die, until the impressions—not very elaborate, but indicating the value of the coin—are completely transferred to both sides of the piece. When about a hundred have been thus dealt with, they are advanced another stage. A frame, so contrived as to receive that number on edge, stands near at hand, and boys place the itzebus within it. Small, star-like indentations are made by force of hammer on the edges of the coins, and this is the finishing touch in the manipulatory processes. Another weighing, however, takes place before the new coins are pronounced fit for circulation. It may so happen that the acid has bitten off too much metal from a small percentage of them, and the final test weighing decides this point. Those which are below a certain weight are returned to the ladle; the others, certified by the addition of an imperial stamp, are true and current money of the realm. In quantities of one hundred, the latter are packed carefully in stout paper, upon which a seal is imprinted, to guarantee to the public the number and quality of the coins within.

The order observable in the silver mint of Jeddo is remarkable. The men, as a rule, work as silently as if they were machines, although there are some hundreds of them engaged. When they enter upon their duties in the morning, they divest themselves of their garments—which are also rather primitive—and don clothes which are the property of the government. At the close of each day's work a gong is sounded, and its effect is magical. Some three hundred men and boys spring to their feet instantaneously. Divesting themselves of their working suits, with a rapidity equal to that which distinguishes clowns and pantaloons under process of transformation at a London theater, they scamper across the mint yard, and perhaps leap over a few hurdles in